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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. |
| 08/651,036 | 05/17/96 | OWEN | 26860/33-47 |

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EXAMINER

MILLS, G

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| ART UNIT | PAPER NUMBER |
| 2106 | 10 |

DATE MAILED: 11/06/97

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

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|------------------------------|--------------------------------------|------------------------------------|
| Office Action Summary | Application No. 08/651,036 | Applicant(s) Owen et al. |
| | Examiner Gregory Mills | Group Art Unit 2106 |

Responsive to communication(s) filed on 8/11/97

This action is **FINAL**.

Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire three month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

Claim(s) 1, 2, 4-18, and 20-30 is/are pending in the application.

Of the above, claim(s) 30 is/are withdrawn from consideration.

Claim(s) _____ is/are allowed.

Claim(s) 1, 2, 4-18, and 20-29 is/are rejected.

Claim(s) _____ is/are objected to.

Claims _____ are subject to restriction or election requirement.

Application Papers

See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

The drawing(s) filed on _____ is/are objected to by the Examiner.

The proposed drawing correction, filed on _____ is approved disapproved.

The specification is objected to by the Examiner.

The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

All Some* None of the CERTIFIED copies of the priority documents have been

received.

received in Application No. (Series Code/Serial Number) _____.

received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____.

Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

Notice of References Cited, PTO-892

Information Disclosure Statement(s), PTO-1449, Paper No(s). 8

Interview Summary, PTO-413

Notice of Draftsperson's Patent Drawing Review, PTO-948

Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

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1. Newly submitted claim 30 is directed to an invention that is independent or distinct from the invention originally claimed for the following reasons:

Originally presented claims 1-20 are drawn to a laser drilling method, classified in class 219, subclass 121.71. Newly presented claim 30 is drawn to a blind via, classified in class 174, subclass 264.

The originally presented invention and newly presented invention are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case the product can be made by another and materially different process. For example, an identical product (product-by-process limitations notwithstanding) could be formed by chemically etching a metal layer, and thereafter laser-ablating a dielectric layer.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, and the search required for the newly presented invention was and is not required for the originally presented invention, restriction for examination purposes as indicated is proper.

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for prosecution on the

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merits. Accordingly, claim 30 is withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

2. Claims 4, 9, and 10 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form. Claims 4, 9, and 10 depend from claim 3, which has been cancelled, and therefore do not further limit a previous claim.

3. Claims 4, 9, and 10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 4, 9, and 10 depend from cancelled claim 3, and are therefore indefinite. They should apparently depend from claim 1, and will be treated as such to allow an action on their merits.

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

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having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103© and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 1, 2, 4-15, and 20-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,593,606 to Owen et al. (Owen '606) in view of U.S. Patent 4,644,130 to Bachmann.

It is first noted that Owen '606 qualifies as prior art under 35 U.S.C. 102(e) for the following reasons. It is the work of "another" as the inventive entity of Owen '606, namely Owen/O'Brien, is different from the inventive entity of the instant application, namely Owen/Larson/Puymbroeck. It has an earlier effective filing date. The effective filing date of the instant application is its actual filing date of 5/17/96, because the presently claimed invention is not supported by the parent application. MPEP 2133.01. The effective filing date of Owen '606 is 7/18/94.

Turning to content, and referring to col. 11, Example 8 in particular ("blind vias were produced by processing the organic dielectric and the metal layers at different peak powers"), and the entire patent in general, Owen '606 discloses a method for laser machining a self-limiting blind via in a multilayered target including at least first and second conductor layers (two layers of cooper in Example 8) having respective first and second conductor ablation thresholds and a

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dielectric layer (epoxy glass or polyimide in Example 8) having a dielectric ablation energy threshold, the conductor layers being above and below the dielectric layer. The method comprises generating a first laser output with a wavelength of less than 400 nm and containing at least one first laser pulse having a first energy density over a first spatial spot size, the first energy density necessarily and inherently being greater than the first conductor ablation energy threshold (or the material would not be removed), applying the first laser output to the target to remove the first conductor layer, generating a second laser output having a wavelength of less than 400 nm and containing at least one second laser pulse having a second energy density over a second spatial spot size, the second energy density being different from the first and necessarily and inherently greater than the dielectric ablation energy threshold (or the material would not be removed), and applying the second laser output to the target to remove the dielectric layer within the second spot area. The first and second laser outputs have different peak powers.

Owen '606 does not specifically state that the second energy density is less than the first and second conductor ablation energy thresholds.

Referring to col. 3, lines 1-5, Bachmann shows that it is known in the art to produce a depthwise self-limiting blind via by applying a laser output to a dielectric layer located above a metal layer such that the energy density of the laser output is greater than the dielectric ablation threshold, but less than the conductor ablation energy threshold. The vias thus produced are said to have a high reliability, as material erosion stops at the conductor layer. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a second

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energy density in Owen '606 of less than the first and second conductor ablation energy thresholds, to ensure that material erosion stops at the lower conductor layer and thereby produce a blind via of high reliability as taught by Bachmann.

Regarding claims 2, 9-13, 20-24, 26, and 27, the features recited therein are clearly shown by Owen '606.

Regarding claims 4, 25, and 28, although Owen does not state how the different powers are achieved, it is well known in the art that the output of a Q-switched laser is inversely proportional to its repetition rate, as lower rep rates allow more energy to be stored in the laser prior to emitting a pulse. Accordingly, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a higher repetition rate when processing the dielectric material to easily achieve the required lower power, in a conventional manner.

Regarding claims 5 and 6, Owen '606 suggests using different powers for the different layers, and a person of ordinary skill in the art, given Bachmann, would have interpreted this as fairly suggesting the use of a higher power for the metal layers than for the dielectric layer, as it was a well-known fact in that art that the ablation threshold for metal is higher than that of the dielectrics of interest.

Regarding claims 7, 8, 14, 15, and 29, although Owen '606 shows changing the energy incident on the target area (i.e., the energy density) by changing the power output of the laser, it would have been equally obvious to one of ordinary skill in the art at the time the invention was made to change the energy density by changing the spot size of the laser upon the target area

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since the examiner takes Official Notice of the equivalence of the step of changing a laser's output power and the step of changing a spot size for their use in the laser machining art and the selection of any of these known equivalents to change the energy density provided on a target surface would be within the level of ordinary skill in the art. In re Fout, 213 USPQ 532 (CCPA 1982). This equivalence may be shown by the equation: $E_d = (P/A) * t$, where E_d is the energy density, P is the beam power, A is the area of the beam spot on the workpiece, and t is the pulse length. The energy density may clearly be set to a desired value by changing either the power or the spot size.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to change the spot size either through using a variable focus lens or by moving the workpiece, both methods being notoriously old and well-known in the art for the purpose of adjusting a laser spot size on a workpiece, to conveniently achieve a required change in size.

Regarding claim 18, Bachmann (col. 3, lines 5-7 and 20) also shows that it is known in the art to laser drill non-circular vias. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the process of Owen '606 to form a non-circular via to produce a desired circuit board configuration as illustrated by Bachmann.

6. Claims 16 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,593,606 to Owen et al. (Owen '606) in view of U.S. Patent 4,644,130 to Bachmann as

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applied to claims 1, 2, 4-15, and 20-29 above, and further in view of U.S. Patent 5,227,013 to Kumar.

As applied above, Owen '606 in view of Bachmann discloses the invention substantially as claimed, but does not show repeating the disclosed process to produce a stepped via as claimed.

Referring to Figure 6, Kumar shows that it is known in the art to laser drill stepped vias in printed circuit boards. It would have been obvious to one of ordinary skill in the art at the time the invention was made to merely repeat the steps of Owen '606 and form a stepped via to produce a desired circuit board configuration as illustrated by Kumar.

7. Applicant's arguments with respect to the pending claims have been considered but are moot in view of the new ground(s) of rejection.

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for response to this final action is set to expire THREE MONTHS from the date of this action. In the event a first response is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period

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will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event will the statutory period for response expire later than SIX MONTHS from the date of this final action.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Gregory Mills whose telephone number is (703) 308-1633. The examiner can normally be reached on Monday through Thursday from 8:30 AM to 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Teresa Walberg, can be reached on (703) 308-1327. The fax phone number for this Group is (703) 305-3431.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-1782.

Gregory Mills
October 29, 1997


TERESA J. WALBERG
SUPERVISORY PATENT EXAMINER
GROUP 2100

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***** NOTICE *****

GROUP 2100 PILOT AFTER FINAL FACSIMILE PROGRAM

Applicant(s) is/are encouraged to respond to this Office action directly to Group 2100 by facsimile transmission at (703) 305-3431 or (703) 305-3432.

Group 2100 Facsimile Numbers

(703) 305-3431

or

(703) 305-3432

The facsimile transmission service is provided as part of Group 2100's After Final program to improve communication with our customers. If this service is utilized please include/use the attached Group 2100 cover sheet. A confirmation copy should not be mailed to the Patent and Trademark Office, see 37 CFR 1.6(d) and 1.8(b).

If surface mail is your preferred delivery option please address your amendment or response to this final Office Action to: Commissioner of Patents and Trademarks; BOX AF; Washington, D.C. 20231

By facsimile transmitting all After Final Office action responses to the above telephone numbers, processing time of the responses is reduced. This will result in more timely responses by the Office and should result in fewer requests for extensions of time.